



Naval Aviation Crew Resource Management (CRM) Initiative

Human Factors QMB/Training Improvements
Working Group Brief

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COMSEACONWINGPAC

26 July 00



Crew Resource Management (CRM) Initiative

- **Naval Air Board Human Factors ESC**
 - **Naval Air Board Human Factors QMB**
 - **Training Improvements Working Group**
 - Initiatives to reduce skill-based and judgment errors:
 - **CADS Beta Test** (standardized data collection, crew feedback, and performance measurement)
 - **Integrated CRM** event-based curriculum (emphasis on situational awareness/decision making)
 - **Advanced Flight Instructor skills** (performance assessment/coaching)
 - **Decision Skills Training** (emphasis on critical thinking)

CRM Goals

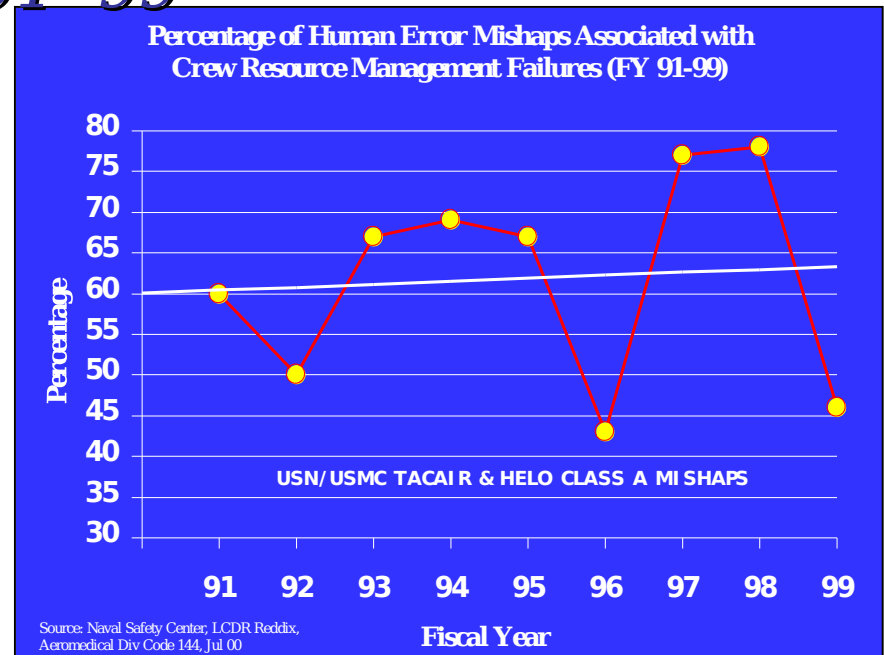
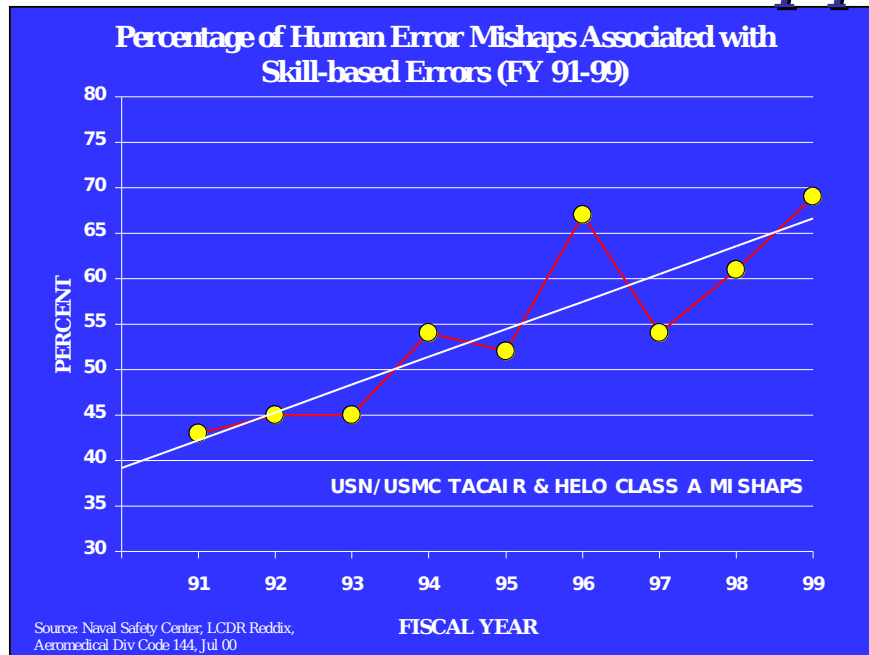
- Reduce mishap rate caused by HF & skill-based errors:
 - Provide aircrews with more realistic, defined training experiences and standards
 - Standardized procedures
- Improve mission performance:
 - Measurable evaluation and improved feedback adapted to each type model aircraft across Air Combat Training Continuum
 - Validate and improve effectiveness of Training and Readiness Matrices

* CRM = Crew Resource Management

Skill-based & CRM Errors

Naval Aviation Mishaps

FY 91-99



CRM Elements

- CRM Elements
 - Operational Risk Assessment & Management
 - Aircraft Flight Control
 - Communication Skills
 - Decision Processes & Skills
 - Situational Awareness
 - Tactical and Standard Operating Procedures
- Integrated CRM elements vice stove-
pipied:
 - NATOPS procedures and checklists
 - Training curriculum and evaluation

* CRM = Crew Resource Management

FAA ACRM Training

Developing Advanced Crew Resource Management (ACRM) Training: A Training Manual

Thomas L. Seamster, Deborah A. Boehm-Davis, Robert W. Holt, and Kim Schultz

August 1, 1998



Federal Aviation Administration
Office of the Chief Scientific and
Technical Advisor for Human
Factors, AAR-100

CRM Initiative



The diagram illustrates the CRM Initiative as a structure supported by three pillars. At the top is a horizontal bar labeled 'CRM Initiative'. Below it are three vertical pillars. Each pillar sits on a base with specific text. The left pillar's base is labeled 'Computer Aided Performance Assessment System and Analysis'. The middle pillar's base is labeled 'NATOPS and Tactical Integration/ Instructional Systems Design'. The right pillar's base is labeled 'Instructor Training and Decision Skills Training'. All three pillars rest on a wide base at the bottom labeled 'CHAIN OF COMMAND SUPPORT'.

**Computer
Aided
Performance
Assessment
System
and
Analysis**

**NATOPS
and
Tactical
Integration/
Instructional
Systems
Design**

**Instructor
Training
and
Decision
Skills
Training**

**CHAIN OF COMMAND
SUPPORT**

CADS™

- **CADS™ Registered trademark of ER Labs for commercial digital playback system in simulators:**

- COTS technology - digital recording, storage, playback of flight & tactics (VS)
- Beta system at VS-41 (FRS) since 1997
- HSL-41 (FRS) system installed 1998
- Airline beta tests (Northwest, Delta)
- Navy Installs in work (simulators):
 - HSL-40 (Mayport)
 - COMSEACONWINGLANT VAQ 139 (FRS)

CAPAS/CADS™

CAPAS - Computer-Aided Performance Assessment System (Navy version)

- Mission Need Statement - CNO approved (May 99)
- Operational Requirements Document (ORD)
 - CINCPACFLT endorsed to NAVAIR (Mar 00)
- **Required Capability (Simulator):**
 - Record audio, video & data (flight & tactics)
 - Debrief & evaluation (subjective & objective)
 - Analysis (immediate and long term) (objective)
 - Archive & edit
- ***Potential for aircraft use***

CAPAS/CADS™ Current Capability

- **Digitally records entire simulator event:**
 - Cockpit, aircraft, flight & tactics (VS) performance data
 - Crew audio and video
 - Aircraft aspect and tactical plot
- **Instructor digitally ‘marks’ places while recording event using Interface Device**
 - Can return instantly to digital marks during debrief, improving fidelity and focus of debriefs
 - Marks become reference for later analysis of CRM performance

* CAPAS = Computer-Aided Performance Assessment

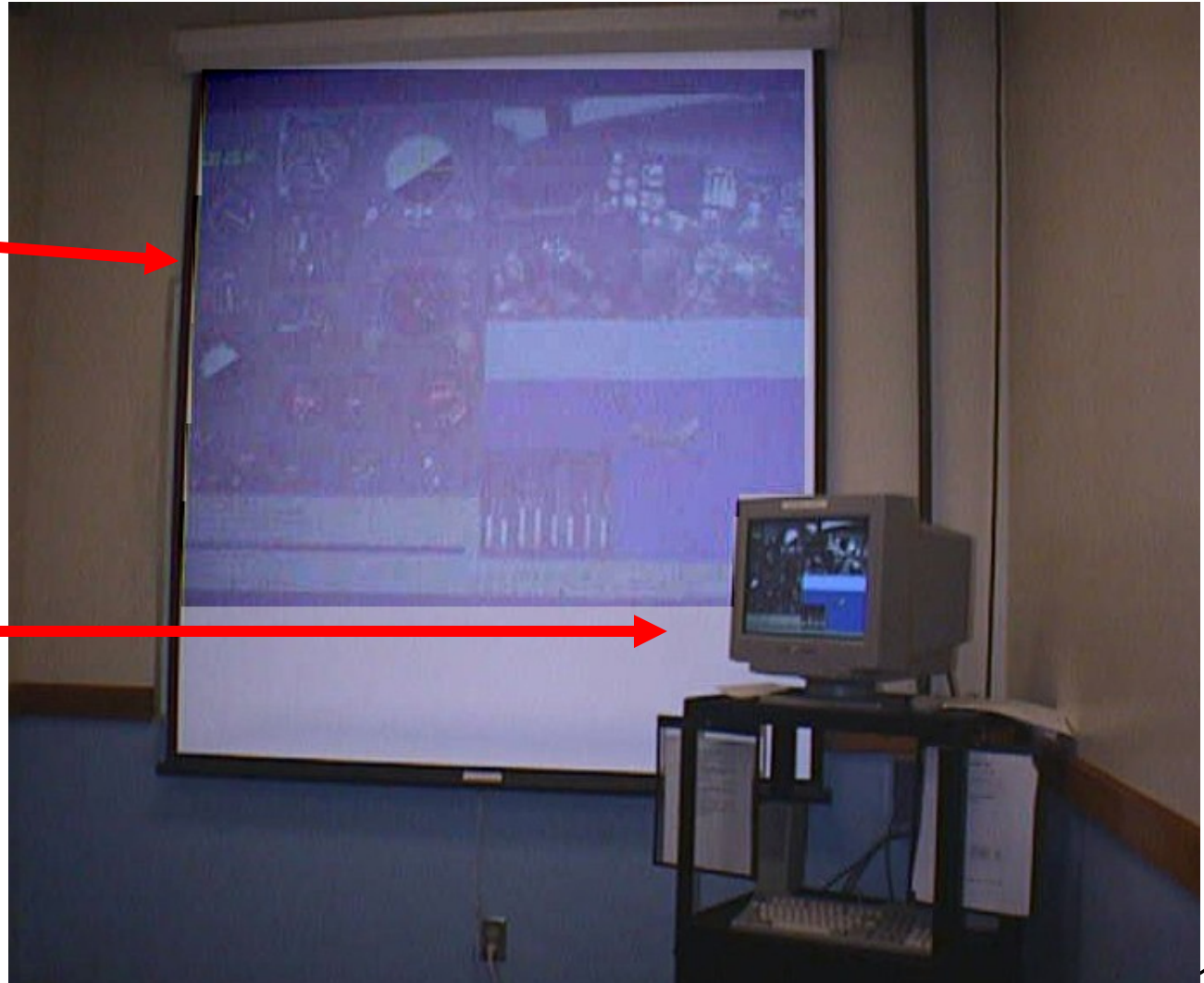
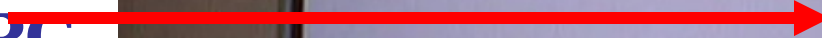
VS-41 Debrief Room

CAPAS/CADS™

**Big screen
display**



Monitor & PC



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Sample CAPAS/CADS™ Display

Cockpit
Instruments

IR
Cockpit
Video
Pilot

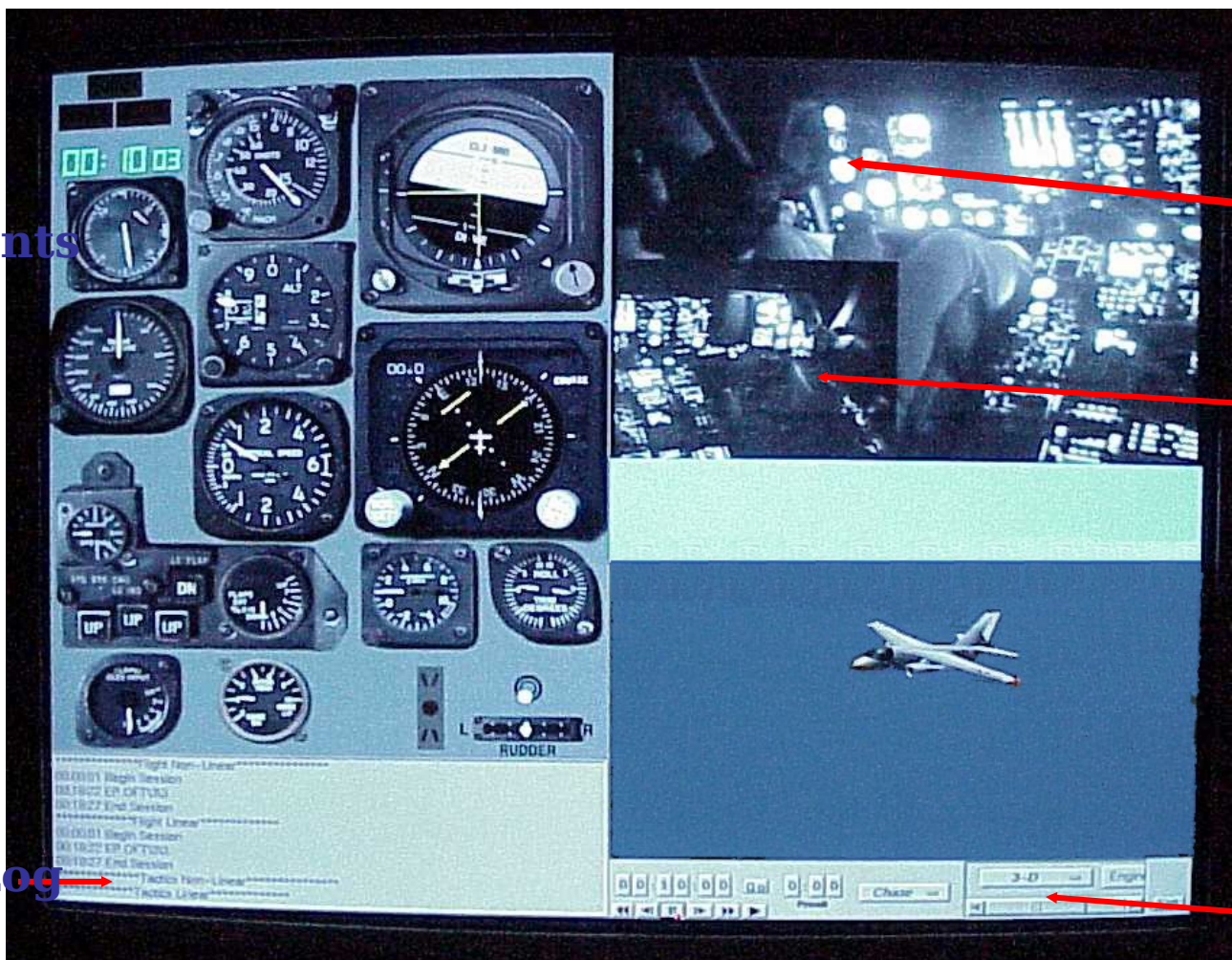
COTAC

Views

- Chase plane
- Tower
- LSO
- Tactical plot

Replay
controls

Marker Log

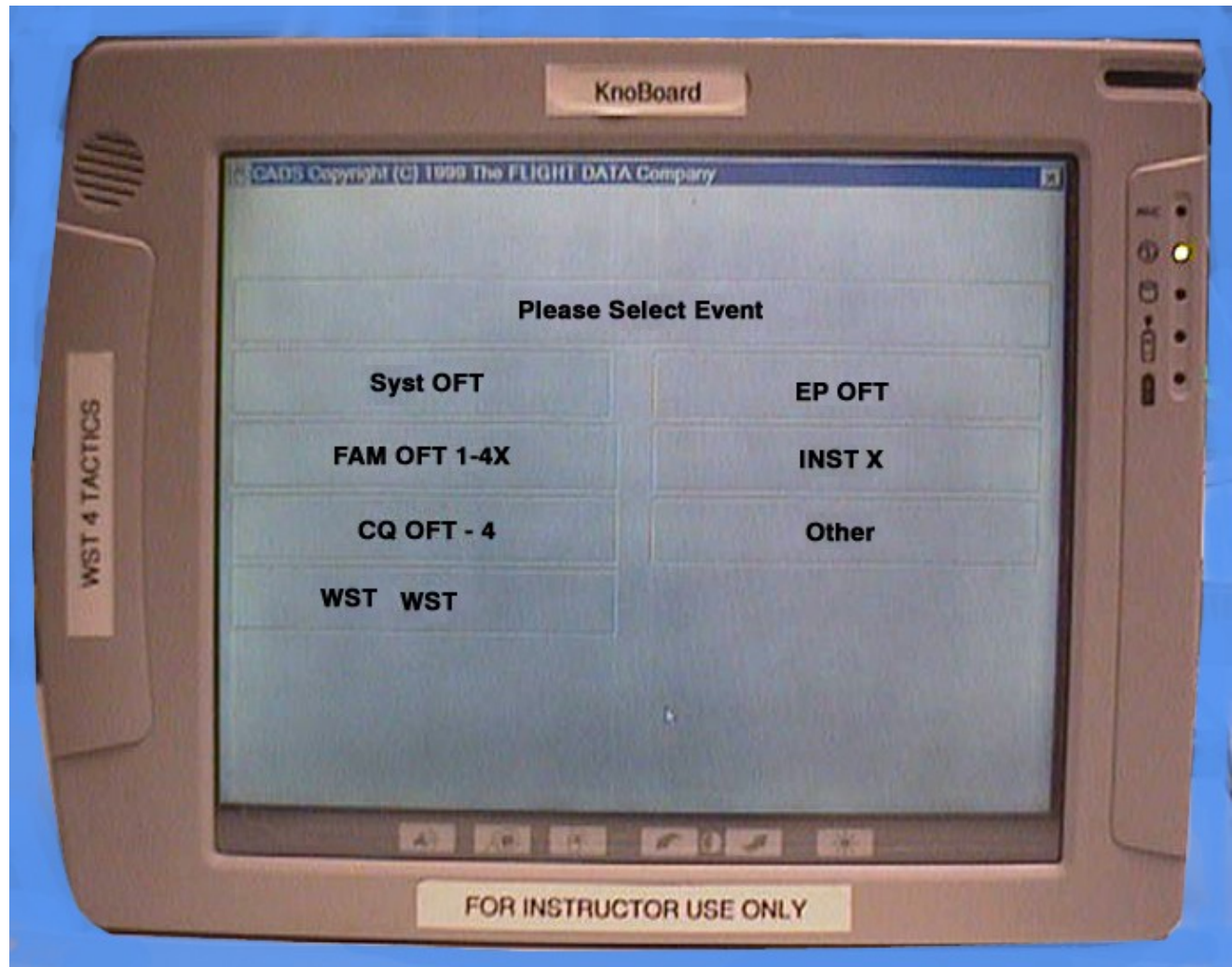


* CAPAS = Computer-Aided Performance Assessment

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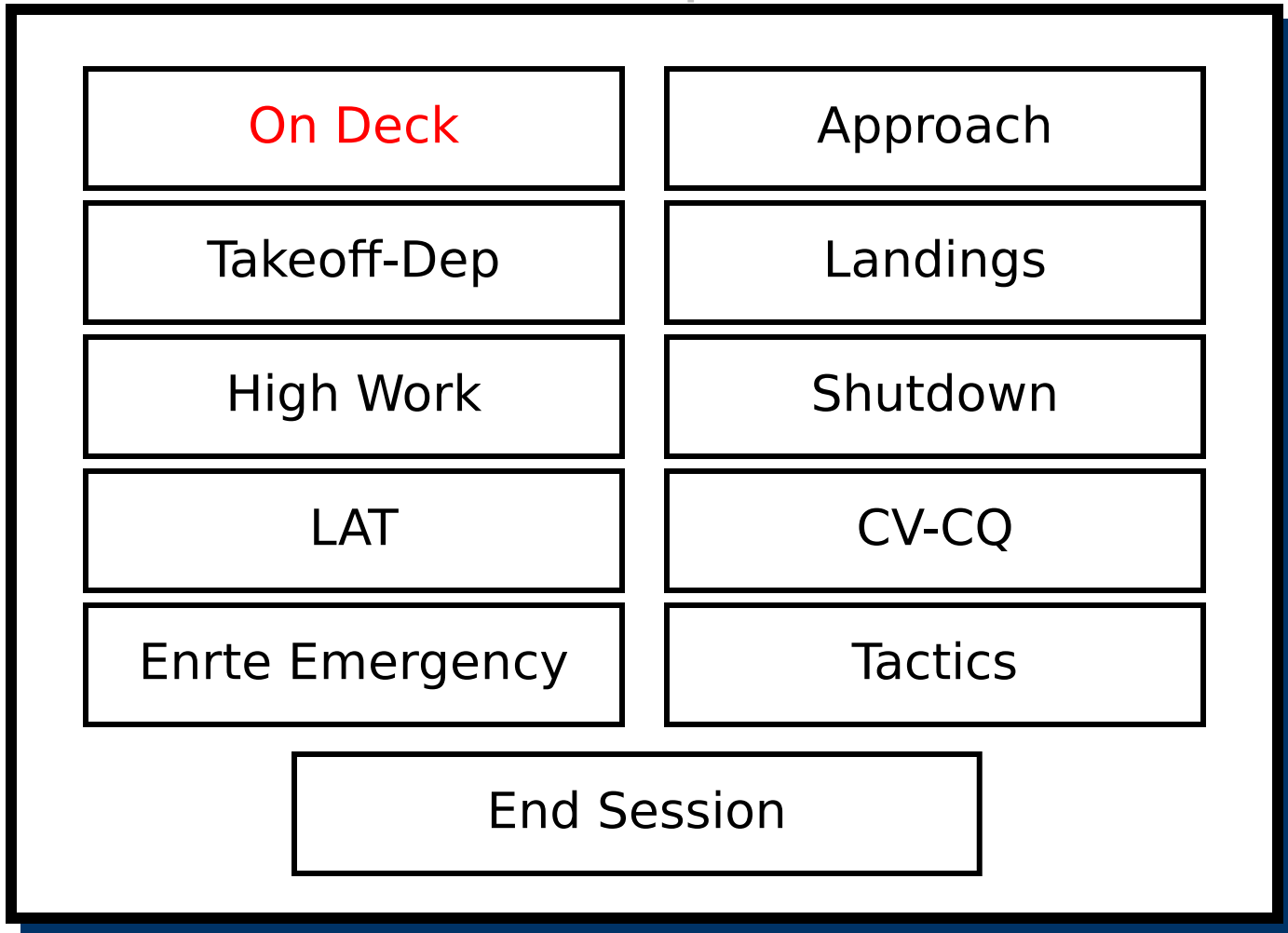
CAPAS/CADS™ Interface Device Example

- Hand held or Mounted
- Programmable

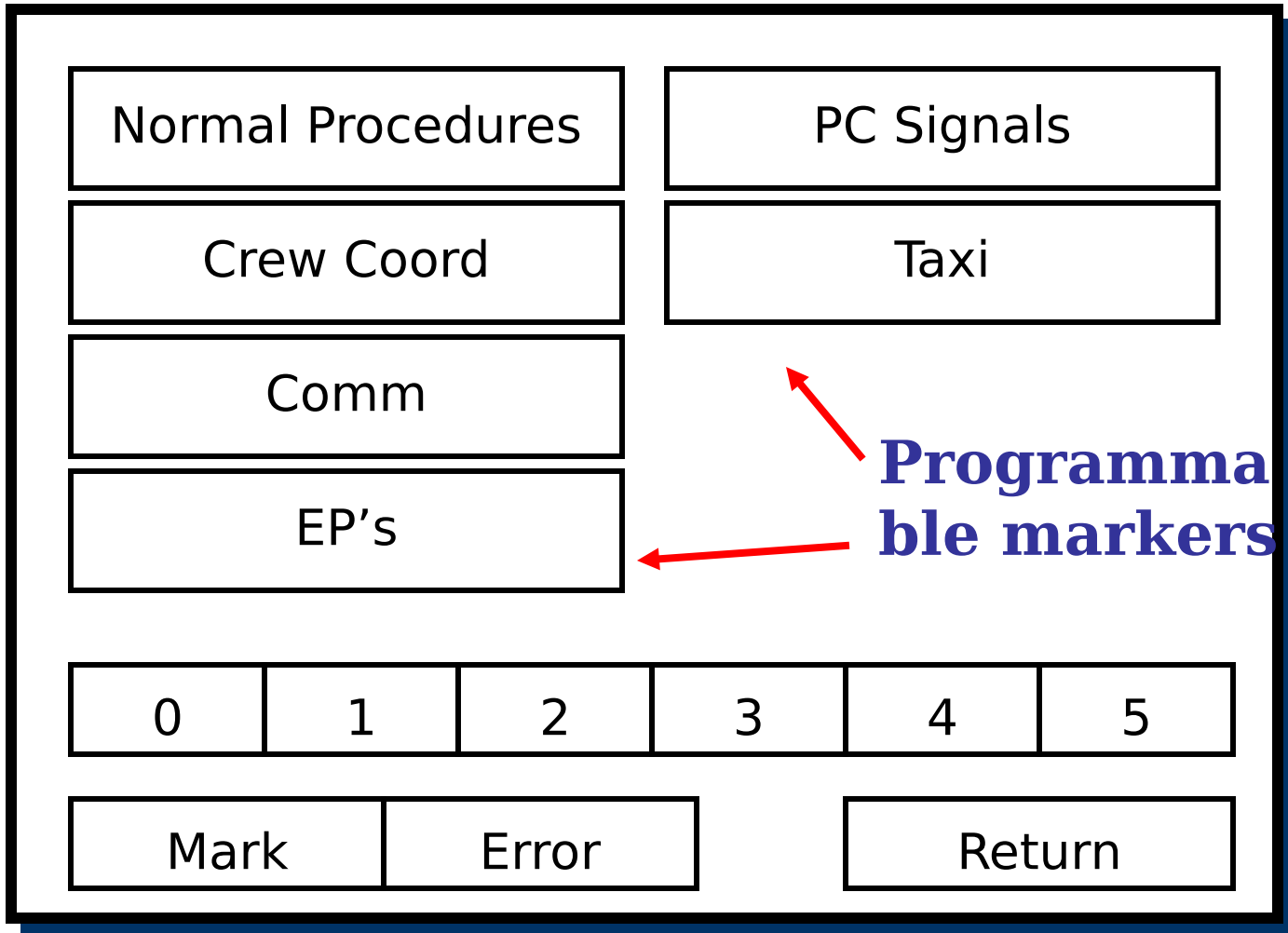


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CAPAS/CADS™ Interface Device Example



Marks within 'On Deck'



CAPAS Usage at VS-41

- **Used to assist assessment and feedback for 18 of 29 simulator events (62%):**
 - 4 Weapon System Trainers (WST)
 - 9 Operational Flight Trainers (OFT/CQOFT)
 - 5 Tactics and Ordnance Trainers
- **System utility varies significantly with event type**
 - Most useful on CRM-intensive WST and OFT events
 - Not as useful on flight/weapon procedural trainers
- **Beyond the debrief**
 - Instructor training & standardization (“SOD/down” review)
 - Establishing an event file library for student review

CAPAS Instructor Training at VS-41

- **6+ hours of CAPAS training for IUT's**
 - Human performance (2.5 hr)
 - Debriefing and Grading (3 hrs)
 - CAPAS operation/hands on application (.5 - 1 hr)
- **Recurrent Training Usage - CADS files**
 - Instructor standardization
 - Debrief/analysis of SODs (“downs”) and “gold standards”
 - “What if?” scenarios
 - *Even mundane events will provoke 10-15 min of discussion*

Planned CAPAS/CADS™ Upgrades

- Next Steps

- Incorporate **video crew de-identification** software
- Install Windows-based drag and drop editing capability (**IT-21 compliant**).
- Add capability to **save edited files to CD-ROM/DVD** for use in classroom and stand-alone Computer-Based Training (CBT)
- *Begin routine flight skill and CRM performance **data collection and analysis.***

CAPAS Benefits

- **Student**

- Focused debrief - immediate access to marked learning points
- Details facilitate self-assessment
- Identify and correct deficient skills at earliest point; create individual performance plans
- Access to archive of best/worst aircrew practices (de-identified)

- **Instructor**

- Improved instructor performance
 - Improved standardization
 - Specific evaluation criteria established and used
 - Ensure event objectives covered
 - Evaluate inter-rater reliability in grading
 - Improved use of debrief time
- Establish and archive best instructional practices (de-identified)

CAPAS Benefits

- **Curriculum**

- Track both individual and group training trends
- Establish/change evaluation & performance standards
- Enhances student/instructor focus on specific knowledge/skill/judgement
 - Identify and eliminate unnecessary objectives
 - More accurate identification of deficiencies
- Incorporate best practices event files throughout curriculum (CBT, instructor training)

Data Collection and Assessment

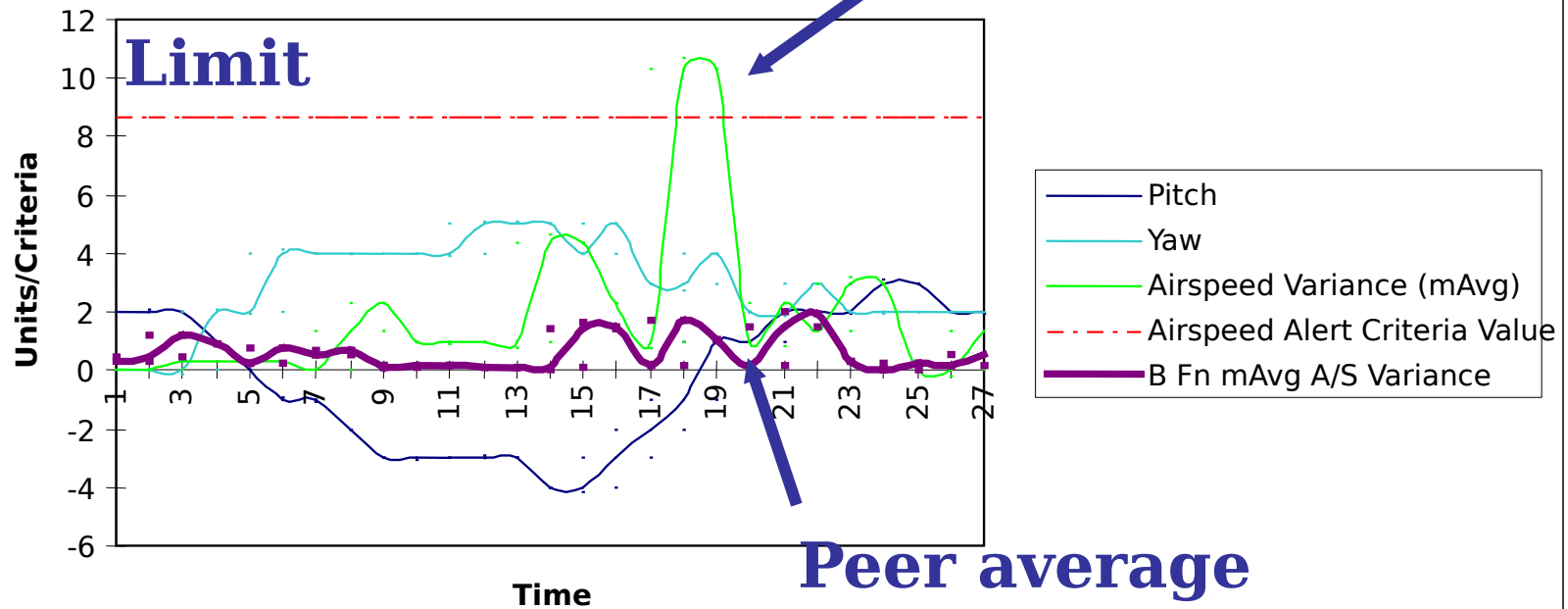
- **Map skill performance against:**
 - Established standards
 - Performance of peers
 - Previous performance (self)

Analyze training and ops data instead of mishap data

CAPAS Analysis Single Event

Airspeed

Sample Data Management Student



Performance Analysis

Learning Curve

***Altitude
Management***

**Pilot's 1st
attempt
Pilot's 2nd
attempt**

a

Pilot's average b

400

SAMPLE DATA

SAMPLE DATA

Data Collection, Assessment & Analysis

- **Aircrews, Instructors, & Training System**

- Provide real-time detailed feedback to aircrews, instructors & training systems
- Objective evaluation
- Diagnose and predict performance
 - Identify behaviors/skill levels that consistently lead to successful mission performance
- Identify rate of skill degradation
- Define underlying/systemic problems that lead to mishaps

- **Analyze training and ops data instead of mishap data**

ACTC Measurement/Feedback

- **Identify behaviors and skill levels that lead to consistent, successful performance**
- **Identify skill degradation rates**
 - Provides objective measurement for T & R Matrix (periodicity)
- **Map skill development and proficiency to establish objective performance standards**
- **Provide real-time, detailed feedback to aircrews, instructors & training system**

*ACTC = Aviation Combat Training Continuum

NATOPS & SOP

- **Will benefit from data gained through current CRM program initiatives:**
 - Identify best crew behaviors/problem areas to:
 - Better define and organize critical elements of NATOPS & SOPs
 - Improved Flight Manuals and Pocket Checklists
 - Human Factors format to reduce crew errors

NATOPS Examples

Current version

OIL SYSTEM MALFUNCTIONS

- *1. Throttle.....Idle; Monitor
Engine Instruments

If abnormal indications persist:

- *2. Throttle.....OFF
*3. FIRE pull handle.....Pull
*4. Ignition switch.....OFF
5. Generator switch.....OFF
6. APU.....Check Altitude,
Airspeed/Start
7. APU automatic shutdown.....Disarm
8. APU GEN switch.....ON
9. BLEED AIR switch.....OFF
10. Hydraulic servo (if No. 2).....OFF
11. Land as soon as practicable.....Refer to
Single-Engine
Landing Procedure

WARNING

If the oil pressure drops to zero, the engine shall be shut down to preclude a catastrophic failure, unless safety of flight dictates otherwise.

Proposed new version

OIL SYSTEM MALFUNCTION

- *1. THROTTLE - IDLE
2. ENGINE INSTRUMENTS - MONITOR

WARNING

If the oil pressure drops to zero, the engine shall be shut down to preclude a catastrophic failure, unless safety of flight dictates otherwise.

IF ABNORMAL INDICATIONS PERSIST:

3. THROTTLE - OFF
4. PRECEED TO NEAREST SUITABLE FIELD FOR LANDING
5. IMMEDIATE ACTIONS COMPLETE,
GO TO ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN
CHECKLIST PAGE [18]

NATOPS Example

*Proposed new NATOPS
procedures that follow-on from
those in the new **OIL
PRESSURE MALFUNCTION**
procedure:*

ENGINE FAILURE FOLLOW-ON PROCEDURES / APPROACH AND LANDING CHECKLISTS

ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN CHECKLIST

- IF ENGINE FAILURE WAS NOT CAUSED BY A MECHANICAL MALFUNCTION OR A GREATER EMERGENCY EXISTS:
- OR**
- BEFORE AIRSTART / ASSISTED AIRSTART
Checklist...PERFORM GO TO PAGE [40]**
- IF ENGINE RESTART WILL NOT BE ATTEMPTED OR ENGINE DOES NOT START:
1. EHP - ON
 2. APU - CHECK
 3. APU AUTOMATIC SHUTDOWN ALTITUDE / AIRSPEED / START - DISARM
 4. APU GEN SWITCH - ON
 5. ___ GENERATOR SWITCH - OFF
 6. ___ BLEED SWITCH - OFF
 7. ___ IGNITION SWITCH - OFF
 8. ___ HYDRAULIC SERVO (IF #2 ENGINE) - OFF
 9. LAND AS SOON AS PRACTICABLE
- OR**
- IF #1 HYDRAULIC SYSTEM IS OPERABLE:
10. CHECKLIST COMPLETE,
GO TO **SINGLE ENGINE APPROACH AND LANDING
CHECKLIST PAGE [45]**
- IF #1 HYDRAULIC SYSTEM INOPERABLE:
11. HYDRAULIC SERVO #1 - OFF
 12. CHECKLIST COMPLETE,
GO TO **SINGLE ENGINE/ #1 HYDRAULIC SYSTEM INOPERABLE
APPROACH AND LANDING CHECKLIST PAGE [46]**

Advanced Curriculum Support

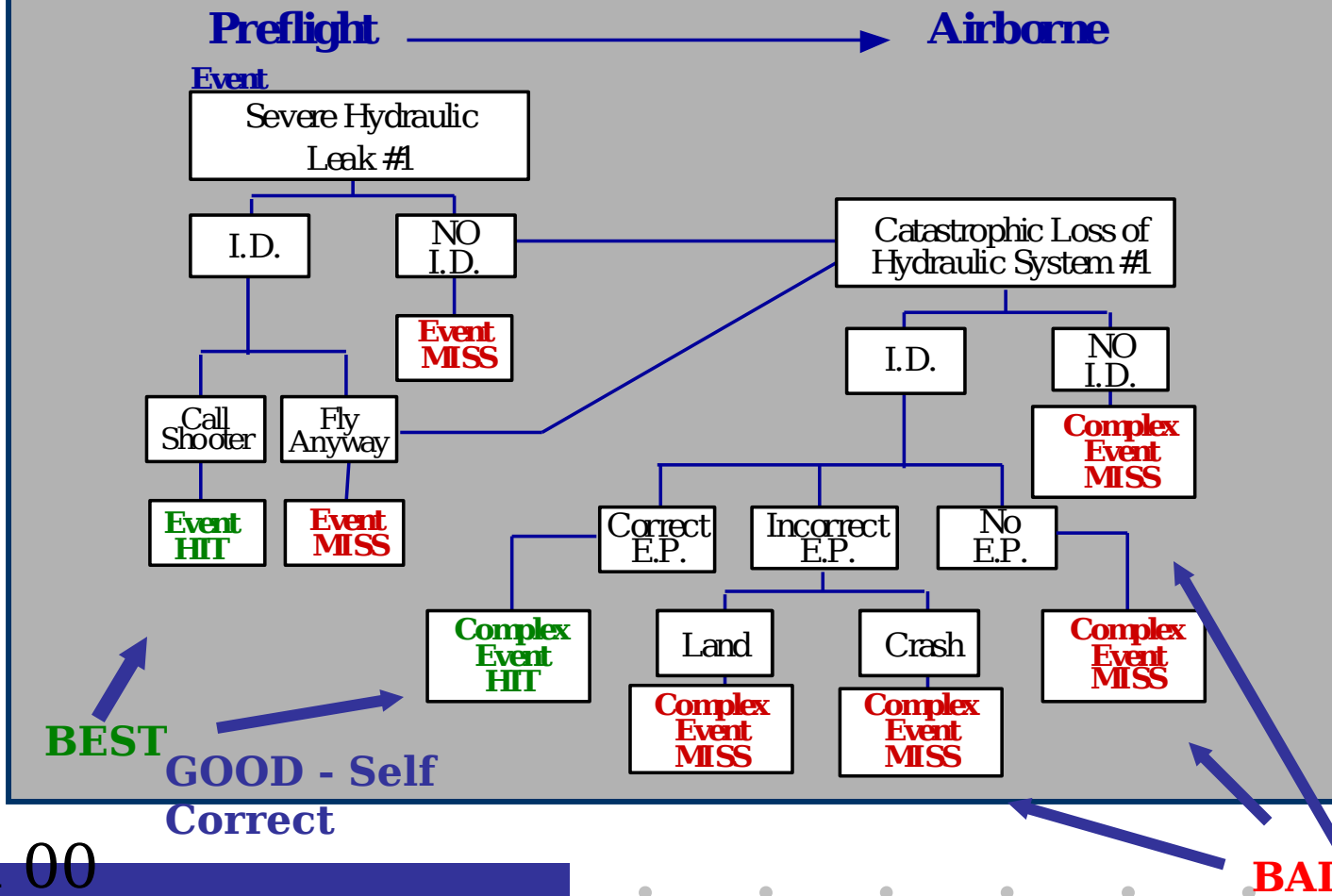
- **Advanced training concepts: instructional techniques and technology**
 - **Human Factors** & performance emphasis
 - **Cognitive & Skill Task analysis:**
 - CAPAS to capture task/mission analysis
 - Interviews to capture experiences & thought processes
 - Integrate **SA and Decision Making** experiences throughout curriculum
 - Lectures, CBT, brief, debrief, evaluations
 - Design curriculum for systematic data collection

Scenario Design/Development

- **Assess skills for effective flight performance and priority of decisions**
 - Address mishap/HAZREP causal factors, tactical and flight performance
 - Create models that correlate crew processes (MOP) to best performance (MOE).
 - Trigger performance against a measurable standard
 - Flight precision skill (stick and rudder)
 - Decision skills (ORM/CRM, NATOPS procedures, SOP, tactical procedures)

Event-Based Scenario

Scenario Decision Tree



Flight Instructor Training

- **Five-day course with practical application**
 - Instructor Team (Ed Spec, CSI, Stan, Curriculum)
 - Human factors integration
 - Instructional techniques & standardization
 - Scenario development
 - Crew evaluation and feedback
 - Decision skills facilitation
- **Assessing Human Performance**
- **Use CAPAS recordings (best & worst)**
 - Practice evaluating instructional techniques and grading events

Flight Instructor Training

- **Ongoing instructor performance data collection and feedback:**
 - Training objectives covered? (Time/quality)
 - Grading criteria used specific to event?
 - Quality of instruction, evaluation and crew performance feedback

Aviator SA/Decision Skills Training

- ***Adaptive Decision Making*** in uncertain, time-constrained situations
- Focuses instructors & crews on critical thinking and problem solving
- Developing plans *and* solutions to realistic situations
- Instructors generate realistic scenarios geared to trigger decisions in various training events (classroom, trainer and in-flight)

Increase versatility in thinking

Aviator SA/Decision Skills Training

- Applies across spectrum of training and operations
- Captures, reinforces & extends thinking skills
- Builds on experience base
 - Practice making decisions in context
 - Develop/enhance pattern recognition skills (SA)
- Facilitates crew self-evaluation
- Maximizes instructor/student interaction

Optimize Decision Making Under Pressure

Integrated CRM Example

Hydraulic System

SCENARIO 1

You are conducting a routine mission in W-291 working area, and the weather at NZY is 2500 OVC with 5 miles of visibility and light rain. You see these indications.



1. Problem
2. Actions to take
3. Critical cues

HYD 14



OPTIONS

In Summary

- CRM training implementation plan integrating:

- **CAPAS hardware, software and analysis**

- Leverage advances in IT to scientifically and systematically improve training and readiness

- **Flight Instructor and decision skills training**

- Increase depth and broaden experience level

- **Curriculum development training and tools**

- Better defines MOP and MOE for more relevant training, assessment, and feedback

CRM/ORM Becomes a Practice ...Not a Program

* CRM = Crew Resource Management

Points of Contact

- Naval Air Board Human Factors QMB,
Training Improvements Working Group

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